



JULY 24, 2017

THE USE OF COAL COMBUSTION ASH- DERIVED MATERIALS AS LANDFILL ALTERNATE DAILY COVER (ADC)

SUMMARY OF ADC CRITERIA, CONSIDERATIONS REGARDING THE
USE OF COAL ASH AS ADC IN PUERTO RICO, REVIEW OF STATE
AGENCY POLICIES, AND EPA REGION 2 RECOMMENDATIONS

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1) Introduction

In sanitary landfill design and operation, daily cover of six inches of compacted soil has been the standard of practice for over 30 years and is a core requirement of RCRA Part 258 Landfill Regulations. Coal ash and coal ash-derived materials (processed coal ash), both originating from the combustion of coal as fuel, have been used as a soil-substitute engineering material, including use as an alternate daily cover for landfills. Individual state policies regarding the use of coal ash as alternate daily cover for landfills differ widely. Coal ash, especially the finer fly ash portion, can present varied challenges in alternate daily cover applications. Coal ash derived materials may successfully address such challenges. The following is a summary of alternate daily cover (ADC) criteria and the use of coal ash as ADC.

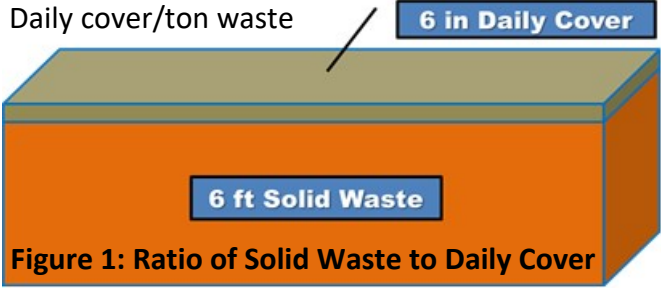
2) Daily Cover

Daily cover provides dust and odor control, a barrier against disease vectors (*e.g.*, dogs, birds), reduces scavenging and fire hazards, contributes to flame retardation, and limits blowing litter. Also, proper daily cover reduces erosion of the landfill surface, increases runoff, and reduces infiltration of storm water. However, when selecting the type of material (*e.g.*, type of soil) the following factors need to be considered:

- Ease of handling & compaction in both wet and dry conditions - Overly cohesive materials may limit operations during rainfall (*e.g.*, clayey soils)
- Contribution to leachate generation - materials with limited permeability and moisture content preferable
- Potential contribution of hazardous constituents to leachate or runoff
- Potential contribution of hazardous constituents to airborne dust or fumes

- e) Introduces no significant, atypical risks (e.g., steel pyrolysis in shredded tires)¹
- f) Material, labor, operational costs
- g) Consistent availability
- h) Porosity/permeability (for both liquids and gases)
- i) Visual aesthetics

3) Waste Generation & Daily Cover Demands

Typical Landfill Operational Values (United States)	
Lift height	6 feet
In situ waste compaction (landfill waste density) ²	526 lbs/cu yd = 0.263 tons/cu yd
Cover soil density ³	1.63 g/cu cm = 102 lbs/cu ft = 2,750 lbs/cu yd
Daily cover (see: Figure 1)	6.0 inches = 0.5 ft = 0.1667 yd
Daily cover/ton waste	871 lbs Daily Cover / ton waste or 12:1 waste to soil volumetric ratio • calculations below
 <p>Figure 1: Ratio of Solid Waste to Daily Cover</p>	
$\frac{\text{Daily Cover}}{\text{Waste}} = \frac{(\text{Cover soil volume})}{(\text{Volume of waste})} = \frac{(1 \times 1 \times 0.1667 \text{ yd}^3)}{(1 \times 1 \times 2 \text{ cu yd})} = \frac{0.08335 \text{ cu yd}}{\text{cu yd}} = 1:12.0 \text{ soil to waste volumes}$	
$\frac{\text{Daily Cover}}{\text{ton waste}} = \frac{(\text{Cover soil density})(\text{Cover soil volume})}{(\text{Volume of waste})(\text{waste density})} = \frac{\left(2,750 \frac{\text{lbs}}{\text{cu yd}}\right)(1 \times 1 \times 0.1667 \text{ cu yd})}{(1 \times 1 \times 2 \text{ cu yd})\left(526 \frac{\text{lbs}}{\text{cu yd}}\right)} = \frac{0.436 \text{ lbs}}{\text{lbs}}$ $= \frac{(0.436 \text{ lbs})}{\text{lbs} \left(\frac{\text{ton}}{2000 \text{ lbs}}\right)} = 871 \text{ lbs Daily Cover / ton waste}$	

¹ U.S. Fire Administration/Technical Report Series, *Special Report: Scrap and Shredded Tire Fires*, USFA-TR-093/December 1998

² EPA HELP Model standard values.

³ soils.usda.gov/sqi/assessment/files/bulk_density_guide.pdf

Puerto Rico Landfill Daily Cover Demand	
PR Waste generation (2010) ⁴	4,089,395 tons/yr
• Green waste diversion	12.6% = 515,000 tons/yr
• Recycling	10% = 409,000 tons/year
• PR Waste disposal in landfills	3,165,000 tons/yr
PR Daily cover demand	1,378,000 tons/year (calculations below)
PR Daily cover airspace demand	264,000 tons/year (in equivalent waste tons)
PR Waste disposal in lined cells ^{5,6}	1,744,549 tons/year
PR Lined landfill daily cover demand	760,000 tons/year (calculations below)
$\text{PR Daily cover demand} = \frac{(871 \text{ lbs Daily cover})}{(\text{ton waste})} \times \frac{(3,165,000 \frac{\text{tons waste}}{\text{yr}})}{(2000 \frac{\text{lbs}}{\text{ton}})} = \frac{1,378,000 \text{ tons Daily Cover}}{\text{year}}$	
$\begin{aligned} \text{PR Daily cover airspace demand} &= \frac{(1 \text{ ton Waste eq Daily cover})}{(12 \text{ ton waste})} \times (3,165,000 \frac{\text{tons waste}}{\text{yr}}) = \frac{264,000 \text{ tons Waste eq Daily Cover}}{\text{year}} \\ &= \frac{264,000 \text{ tons Waste eq Daily Cover}}{\text{year}} \times \end{aligned}$	
$\text{PR Lined landfill Daily cover demand} = \frac{(871 \text{ lbs Daily cover})}{(\text{ton waste})} \times \frac{(1,744,549 \frac{\text{tons waste}}{\text{yr}})}{(2000 \frac{\text{lbs}}{\text{ton}})} = \frac{760,000 \text{ tons Daily Cover}}{\text{year}} \times$	

Note: For comparison, the AES Puerto Rico, operators of the only coal-fired power plant in Puerto Rico, generates Agremax, a coal ash derived material, at an approximate rate = 4,000 tons/week = 200,000 tons/year (see Figure 2).



Figure 2: The AES Plant and Lined Landfill Cells in Puerto Rico

⁴ Dynamic Itinerary for Infrastructure Projects Technical Report, PR-SWMA, Feb 2007.

⁵ Cabo Rojo, Carolina, Fajardo, Humacao, Peñuelos, Ponce, Salinas, and Toa Alta all currently employ a lined cell. Vega Baja and Toa Baja have lined cells under construction. Juncos has one in the planning stage. Peñuelos, Ponce, & Salinas are operated as private landfills. All others are privately operated but municipally-owned.

⁶ DECA-RCB notes.

4) Alternative Daily Cover (ADC) Benefits

The use of alternative materials (*i.e.*, other than soil) for daily cover provides several benefits:

- a) ADC Conserves Soil for Agricultural or Construction Purposes
 - i) Some 1.4 million tons of soil is now used each year in Puerto Rico for landfill daily cover
- b) ADC Limits Mining in Sensitive Ecosystems
 - i) On-site soil mining of daily cover is common in Puerto Rico
 - ii) 70% of the active landfills in Puerto Rico are sited in or adjacent to sensitive ecosystems (*e.g.*, karst, endangered species habitat, wetlands)
- c) ADC Conserves Airspace (landfill waste capacity) Within Landfill
 - i) Certain ADC options may be thinner, effective daily cover (*e.g.*, tarps and foam effectively use zero airspace)
 - ii) Diversion of waste for use as cover (*i.e.*, if it's used as ADC there is no net loss of landfill waste capacity as there is with soil- *e.g.*, construction and demolition debris employed as ADC)
- d) Revenue Generation/Cost Reduction
 - i) Certain ADC options, such as ash mixtures, may be cheaper than available soil options or even a net source of revenue

5) Coal Combustion Ash as ADC

a) Operational Considerations

Like other forms of daily cover, coal combustion ash can present challenges when used as ADC. Many of these challenges can be adequately addressed by experienced operators and through additional processing prior to application (*e.g.*, production of coal ash derived materials). Coal ash can consist of bottom ash (coarse grained particles) and/or fly ash (finely divided, silt-sized particles). Factors regarding the use of coal ash as ADC include:

- i) Bottom ash is a permeable material
- ii) Fly ash can be a cementitious material and may form a relatively impermeable layer when compacted (as in ADC), adversely impacting leachate flow and collection
- iii) Coal ash can be combined with soil, sludge, and lime to improve the consistency and workability and minimize adverse leachate flow and collection impacts
- iv) Handling difficult when dry (fly ash)
- v) Dust issues when dry (especially fly ash)
- vi) When dry may provide poor barrier to disease vectors (*e.g.*, dogs, birds)

- vii) May be susceptible to combustion (may sustain a landfill fire)⁷
- viii) May present a higher risk of slope failures due to variability in shear strength
- ix) More susceptible to washout in heavy rains with runoff management concerns (fly ash)
- x) Potential issues (*e.g.*, contaminated leachate/runoff risk) if stored/staged improperly
- xi) Greater compacted thickness (6 to 12 inches) needed than soil or certain other ADC materials (*e.g.*, spray-on slurries/foam),⁸ leaving less available air space for waste disposal
- xii) Landfill gas collection impact:^{9, 10}
 - (1) Bottom ash is a permeable material and is unlikely to impact gas collection or production
 - (2) Fly ash can be a cementitious material and may form a relatively impermeable layer when compacted (as in ADC), adversely impacting vertical landfill gas flow and collection.
 - (3) Limited experimental results suggest higher rate of landfill gas production (more rapid biodegradation with higher settlement rate was found with a coal ash derived material: Agremax)¹¹
 - (a) High landfill gas production rates in landfills with gas collection systems are generally desirable
 - (4) Fly ash and, to a lesser extent, bottom ash from coal-fired power plants contains SO_x which, when neutralized, forms sulfur salts (*e.g.*, SO₃²⁻). When these materials are exposed to either municipal solid waste or MSW leachate under anaerobic conditions in a biologically active system, hydrogen sulfide (H₂S) is produced as described by the equation:¹²
 - (a) Organic matter (waste) + SO₃²⁻ + H₂O → H₂S + 2CO₂
 - (5) Conversely, coal ash has been recommended to reduce odors in landfills (particularly from H₂S),¹³ as coal bottom ash has been demonstrated to adsorb H₂S from both landfill leachate and landfill gas.¹⁴

⁷ *Alternative Daily Cover Materials for Municipal Solid Waste Landfills*, U.S. EPA Region 9, 1992.

⁸ *Alternative Daily Cover White Paper*, California Integrated Waste Management Board, October 2009

⁹ <http://gobroomecounty.com/files/dpw/pdfs/Issue%20Paper%20%234%20-ADC.PDF>

Draft Solid Waste Management Plan Update, Issue Paper #4 - *Availability of Permeable Daily Cover Material for Landfill Operations*, Broome County, NY

¹⁰ <http://www.flyash.info/2009/154-hwang2009.pdf> *Biochemical Response of Landfill with Manufactured Aggregates as Daily Cover*. World of Coal Ash Conference, Lexington, KY, May 4-7, 2009, Zalleris Escobar, Yahaira Lugo and Sangchul Hwang.

¹¹ http://prt2.uprm.edu/img/uprm_uri_presentations/summer_07/Cory_Presentacion.pdf *Settlement of Landfills Related to Post-Closure Construction*, URI-UPRM Eisenhower Fellowship Program, 2007

¹² <http://www.wastesymposium.com/gws2012/CUSTOM/Uploads/DelaCruzFlorentinoFinalAb12-Sulfide.pdf>

¹³ www.mass.gov/eea/docs/dep/recycle/laws/lfgaspol.doc *Control of Odorous Gas at Massachusetts Landfills*, Massachusetts Department of Environmental Protection, Bureau of Waste Prevention, 9/4/2007

¹⁴ <http://www.tandfonline.com/doi/pdf/10.1080/10473289.2001.10464317> *Removal of Hydrogen Sulfide Gas and Landfill Leachate Treatment Using Coal Bottom Ash*, ISSN 1047-3289 J. Air & Waste Manage. Assoc. 51:939-945.

Note: In 2005, EQB approved Agremax, a coal ash derived material, for use as ADC at the Salinas PR landfill as a pilot project (which was subsequently never conducted).

b) Properties of AGREMAX, a Coal Ash Derived Material^{15, 16, 17}

i) General description

(1) Agremax is a manufactured aggregate

(a) Mixture of fly ash (20%) and bottom ash (80%) which is hydrated and then dried, resulting in a pozzolanic reaction that produces a cementitious aggregate

(b) Fly ash component: finely divided, silt-sized particles

(c) Bottom ash component: coarse grained particles (gravel to fine sand)

(2) Shear strength higher than that of natural soils means resistance to deformation due to traffic

(3) Relatively easy to compact

(4) Low potential for expansion due to water absorption

(5) Specific gravity

(a) Fine particles (<2.36mm) –SG 2.69

(b) Coarse particles (>2.36mm) –SG 1.16

(6) pH for a 1:5 ratio of Agremax to water = 10.5 average

ii) Physical description:

(1) Silty sandy gravel, some clay (gravel~41%, sand~28%, fines~31%)

(2) Permeability (D2434-68/2000) = 4.4×10^{-6} cm/sec (for ref., RCRA §258 landfill cap permeability @ 1×10^{-5} cm/sec or less)

iii) Chemical description of manufactured aggregate:

Analysis of manufactured aggregate	% Wt
Silica, SiO ₂	34.79
Alumina, Al ₂ O ₃	11.97
Ferric Oxide, Fe ₂ O ₃	4.19
• SiO ₂ + Al ₂ O ₃ + Fe ₂ O ₃	• 50.95
Titania, TiO ₂	0.51
Lime, CaO	29.67
Magnesia, MgO	1.11
Potassium Oxide, K ₂ O	0.76
Sodium Oxide, Na ₂ O	1.52
Sulfur Trioxide, SO ₃	14.66

¹⁵ http://prt2.uprm.edu/img/uprm_uri_presentations/summer_07/Cory_Presentacion.pdf Settlement of Landfills Related to Post-Closure Construction, URI-UPRM Eisenhower Fellowship Program, 2007

¹⁶ <http://www.agremax.com/Downloads/Tab%2010%20-%20Geotechnical%20Reports.pdf> AES, Puerto Rico lab test results, February, 2006.

¹⁷ http://agremax.com/Downloads/Final_Report_march2006_revised_logo.pdf Possible Applications for Circulating Fluidized Bed Coal Combustion By-Products from the Guayama AES Power Plant. Prepared for: AES Puerto Rico, LP Guayama, Puerto Rico.

Phosphorus Pentoxide, P ₂ O ₅	0.32
Strontium Oxide, SrO	0.23
Barium Oxide, BaO	0.24
Manganese Oxide, Mn ₃ O ₄	0.03
Undetermined	0
Alks. As Na ₂ O, Dry Coal Basis	1.76
Analysis of manufactured aggregate	----
Base:Acid Ratio	0.79
T250 Temperature ¹⁸	2,198°C

c) Coal Ash Health Risks

The constituents of concern associated with coal ash include antimony, arsenic, barium, beryllium, cadmium, hexavalent chromium, lead, mercury, nickel, selenium, silver, and thallium. EPA believes that the metals identified are sufficiently toxic that they are capable of posing a substantial present or potential hazard to human health and the environment when coal ash is improperly treated, stored, transported, disposed of, or otherwise managed. Such hazards include inhalation of fugitive dust.¹⁹

6) PR-EQB Regulations Regarding ADC

Summary of the operational, daily cover, and monitoring requirements established for landfills in the Puerto Rico Environmental Quality Board's (PR-EQB) *Regulations for the Management of Non Hazardous Solid Wastes* (RMNHSW):

- CHAPTER IV: Provisions for Sanitary Landfill Systems
 - Part IV-A: Design Criteria
 - RULE 546 Requirements for Cover Material
 - A. No person shall cause or allow the operation of an SLS [Sanitary Landfill System] without the application of suitable cover material.
 - B. Owners or operators of an SLS shall cover the solid waste disposed of at the facility with no less than six (6) inches of compacted fill material at the end of each day's operation. If necessary, this shall be done at more frequent intervals in order to control vectors, fire, offensive odors, dispersion of waste by the wind and scavenging of waste.
 - C. Owners or operators interested in using a cover layer that is thinner than the one mentioned above, or cover material that requires greater thickness, or an equivalent material, shall submit a waiver request to the Environmental Quality Board in which they show that the alternative cover materials and the proposed thickness are adequate for controlling vectors, fires, offensive odors, dispersion of

¹⁸ T250 Temperature is the temperature at which the slag would begin to flow.

¹⁹ Federal Register / Vol. 75, No. 118 / Monday, June 21, 2010 / Proposed Rules /

waste by the wind and scavenging of waste, without representing a risk to human health and the environment.

- RULE 557 Detection Monitoring Program
 - A. Every owner or operator of an SLS shall establish an underground water monitoring system, using at least the constituents of Table I of this Chapter:²⁰

CHEMICAL SUBSTANCE	MCL (mg/L)	CHEMICAL SUBSTANCE	MCL (mg/L)
Arsenic	0.05	Lead	0.05
Barium	1.0	Mercury	0.002
Cadmium	0.01	Methoxychloride	0.1
Carbon tetrachloride	0.005	Nitrate	10
Hexavalent chromium	0.05	Selenium	0.01
2,4-dichlorophenoxyacetic acid	0.1	Silver	0.05
1,4-dichlorobenzene	0.075	Toxaphene	0.005
1,2-dichloroethylene	0.007	1,1,1-Trichloroethylene	0.2
Endrin	0.0002	Trichloroethylene	0.2
Fluoride	4.0	2,4,5-Trichlorophenoxyacetic acid	0.01
Lindane	0.004	Vinyl chloride	0.002

7) Published Summaries on State Policies Regarding Coal Combustion Ash-derived ADC

Published summaries of State policies differ significantly in reporting State-specific use of coal combustion by-products as ADC.

Publication	States Included in the Discussion	Comments
California Integrated Waste Management Board: <i>Alternative Daily Cover White Paper</i> , October 2009 • www.calrecycle.ca.gov/lea/Regs/Review/AltDailyCovr/AltDailyCvr.pdf	California	<ul style="list-style-type: none"> • Board-Approved ADC: Ash and Cement Kiln Dust Materials (closest technical analog to coal ash, which itself is not allowed) • Minimum compacted thickness of 6 inches and average compacted thickness of less than 12 inches
	Massachusetts	<ul style="list-style-type: none"> • Coal bottom ash allowed as ADC
	Michigan	<ul style="list-style-type: none"> • Ash from combustion of coal or wood allowed as ADC
	Minnesota	<ul style="list-style-type: none"> • No regulations on ADC • Allowable ADC materials: Soil and soil-like waste materials • The placement of new coal ash is counted as cover on older coal ash in coal ash monofills
	Missouri	<ul style="list-style-type: none"> • Fly ash/bottom ash mixture (up to 50% bottom ash) allowed as ADC
	Ohio	<ul style="list-style-type: none"> • Coal combustion bottom ash allowed as ADC

²⁰ Significant inorganic constituents of coal ash include: arsenic (As), barium (Ba), cadmium (Cd), chromium (Cr), lead (Pb), mercury (Hg), and selenium (Se).

Publication	States Included in the Discussion	Comments
		<ul style="list-style-type: none"> • Considers fly ash unsuitable for ADC use due to significant potential for dust
	Washington State	<ul style="list-style-type: none"> • Alternative materials and/or alternative thickness other than at least six inches (15 centimeters) of earthen material may be approved by the jurisdictional health department
	Wisconsin	<ul style="list-style-type: none"> • Bottom ash allowed as ADC • Does not allow fly ash as ADC
	Wyoming	<ul style="list-style-type: none"> • Any cover including no less than six inches of compacted soil or any alternative material approved by the administrator
EPA & National Center for Manufacturing Sciences: <i>Gateway to State Tools</i> <ul style="list-style-type: none"> • http://www.envcap.org/statetools/brsl/ Beneficial Use State Recourse Locator. See also: <ul style="list-style-type: none"> • http://www.envcap.org/statetools/index.cfm 	Hawaii Iowa Massachusetts Michigan North Dakota Virginia	<ul style="list-style-type: none"> • States that have approved this material for beneficial use either on a case-by-case or pre-approved basis: <ul style="list-style-type: none"> ○ Coal Bottom Ash - landfill uses, such as daily cover
	Iowa Massachusetts Michigan Virginia	<ul style="list-style-type: none"> • States that have approved this material for beneficial use either on a case-by-case or pre-approved basis: <ul style="list-style-type: none"> ○ Coal Fly Ash - landfill uses, such as daily cover
American Coal Ash Association (communication w/EPA R2, January 2014)	California Iowa Michigan Utah	<ul style="list-style-type: none"> • States that specifically list coal ash as an acceptable alternative daily cover for landfills
The U.S. Department of Energy, Office of Fossil Energy: <i>Database of State Regulations Affecting Disposal and Utilization of Coal Combustion By-products</i> <ul style="list-style-type: none"> • http://www.netl.doe.gov/research/coal/crosscutting/environmental-control/solid-waste/state-regulations/select-state 	Alabama Alaska Arkansas California Colorado Delaware Georgia Illinois Indiana Iowa Kentucky Maine Maryland Massachusetts Michigan Missouri Nebraska New Hampshire New Jersey New Mexico	<ul style="list-style-type: none"> • In summary, laws, regulations, policies and/or guidance authorizing at least limited coal combustion by-products reuse have been adopted in each of the listed states • Detailed links to individual states include: <ul style="list-style-type: none"> ○ State summaries ○ State contact information ○ Detailed review of State coal combustion by-product regulations • Example: Iowa <ul style="list-style-type: none"> ○ http://www.netl.doe.gov/research/coal/crosscutting/environmental-control/solid-waste/state-regulations/oklahoma ○ Summary: <ul style="list-style-type: none"> • Iowa regulations adopt by reference the federal regulation that exempts coal combustion by-products (CCB) (including fly ash, bottom ash, slag, and flue gas emission control waste generated primarily from the

Publication	States Included in the Discussion	Comments
	New York North Carolina North Dakota Ohio Oklahoma Pennsylvania South Carolina Tennessee Texas Utah Vermont Virginia West Virginia Wisconsin	<p>combustion of coal) from classification as hazardous waste.</p> <ul style="list-style-type: none"> ○ State contact information: <ul style="list-style-type: none"> • Jon Roberts, Solid Waste Programs Director Oklahoma Department of Environmental Quality PO Box 1677, Oklahoma City, OK 73101-1677 Phone: (405) 702-5100 Website: www.deq.state.ok.us ○ Detailed review of State coal combustion by-product regulations: <ul style="list-style-type: none"> • Exempt from hazardous waste regulation are fly ash, bottom ash, slag, and flue gas emission control waste generated primarily from the combustion of coal: OAK. REG. 252:205-3-2(c); 40 CFR 261.4. • According to a February 29, 2000, CCB Policy Statement, the Oklahoma Department of Environmental Quality currently allows the following uses of CCBs without prior approval when used according to the applicable standard (generally American Society for Testing and Materials): cementitious material production; daily landfill cover (with permit modification); as manufactured product, road base, road surfacing material; solidification/chemical fixation; deicing; soil stabilization; subgrade treatment; engineering applications; and mine reclamation. Records of reuse and disposal of CCBs must be kept, and storage shall be in an environmentally appropriate manner to prevent releases to the environment.

8) EPA Survey of State-by-State Use of Coal Combustion By-Products as ADC

As the above section 7) *Published Summaries on State Policies Regarding Coal Ash-derived ADC* suggests, Web-based sources differ significantly in reporting State-specific use of coal combustion by-products as ADC. EPA Region 2 surveyed the following selected states for specific policies and experience with coal combustion by-products use as ADC:

State	Contact Information	Comments
Alabama	Scott Story, Chief Solid Waste Eng. Section Solid Waste Program Alabama Department of Environmental Management (334) 271-7700	<ul style="list-style-type: none"> • In the past, coal ash was exempt from the definition of solid waste and was widely employed in place of soil (including ADC) • Regulations were recently modified to remove coal ash exemption

State	Contact Information	Comments
	adem.alabama.gov	<ul style="list-style-type: none"> Coal ash is currently allowed only in municipal solid waste landfills as ADC and its use is addressed through the landfill permit process Coal ash is allowed only as ADC and is not permitted as intermediate or final cover or slope stabilization No differentiation has been made by the Department between bottom and fly ash Coal ash is allowed directly as ADC (<i>i.e.</i>, it's not required to be combined with soil, sludge, and lime to improve the consistency and workability) Not presently being employed as ADC or any other beneficial reuse as supply is being stored/stockpiled by generators Some problems, including workability and runoff concerns, were noted with coal ash as ADC but they were not viewed as significant or insurmountable
California	Steve Santa Croce (530) 913-1838 or (916) 341-6688	<ul style="list-style-type: none"> There are no landfills approved for coal ash as ADC. The ash defined in the October 2009 white paper is cement kiln ash.
Hawaii	Lene Ichinotsubo Department of Health Office of Solid Waste Management P. O. Box 3378 Honolulu, HI 96801 (808) 586-4226 www.state.hi.us	<ul style="list-style-type: none"> Currently coal ash is not being used as ADC One landfill is using coal ash, a mixture of fly and bottom ash, as an operations layer between the liner and the waste at a C&D landfill. C&D landfills are not required to have daily cover.
Iowa	Mike Smith Iowa Department of Natural Resources (515) 281-8394	<ul style="list-style-type: none"> Iowa allows coal combustion by-products mixed with soil (50/50) to be used as ADC and Iowa regulations do not specify what type of coal ash must be used Iowa DNR field personnel did not like fly ash being used with a soil mixture as ADC. Field personnel found that bottom ash mixed with soil performed well but fly ash mixed with soil created a lot of dust. They did not view the fly ash as ADC favorably. <p>Note: The inspectors also felt that both types of ash, even mixed with soil, were hard on landfill equipment</p>
Massachusetts	Paul Emond Massachusetts Department of Environmental Protection One Winter Street Boston, MA 02108 (617) 292-5974 paul.emond@state.ma.us www.mass.gov/dep	<ul style="list-style-type: none"> Fly ash as ADC produces a dust issue and if a facility would request to use it as ADC, the request would be denied A mix of fly ash, bottom ash and soil provides good ADC. This mix has been found to control odors and structurally and physically performs well MA doesn't have too many coal generating facilities so they don't have ash at many landfills

State	Contact Information	Comments
		<ul style="list-style-type: none"> • In MA, it is exempt as a hazardous waste but is classified as a solid waste • MA DEP approves use of coal ash as ADC on a case by case basis but also requires Town (where the landfill resides) approval. When a request comes in, MADEP wants to know the composition of the ash and the percentages
Michigan	Duane Roskoskey Solid Waste Section Michigan Department of Environmental Quality P.O. Box 30241 Lansing, MI 48909 517-284-6593 roskoskd@state.mi.us www.michigan.gov/deq	<ul style="list-style-type: none"> • Michigan ADC approval requirements: • http://www.michigan.gov/documents/deq/deq-owmrp-policy-115-10_408155_7.pdf • Michigan has 3 landfills currently using coal ash as ADC. All of them are bottom ash only, no fly ash • Most of Michigan's coal fired power plants have their own landfills so don't have a need to dispose of coal ash offsite • The Department's Solid Waste Program is funded through disposal fees so the use of coal ash as ADC is still considered disposal (allowing collection of "disposal" fees by the Department) and It is regulated as a solid waste • The bottom ash is typically mixed with other ADC materials such as foundry sand and auto shredder residue • The ash must meet the ADC approval requirements but has been working well
Virginia	Don Brunson Virginia Department of Environmental Quality 629 Main Street Richmond, VA 23219 (804) 698-239 www.deq.state.va.us	<ul style="list-style-type: none"> • VA has landfills that use coal ash as ADC • Most of it is fly ash mixed with soil (50/50 mix) • Bottom ash is used for other beneficial uses in concrete and in foundations • Coal ash is exempt as a solid waste if used for beneficial use • The landfill needs to submit a beneficial use request and they have a 180-day demonstration period using coal ash as ADC. Most have been approved and then require a permit modification • Found no issues, including dust, with the fly ash mixture

9) EPA Region 2 RCRA Compliance Branch Recommendations

We believe that coal ash and coal ash-derived materials such as Agremax may reasonably be used as ADC when the following conditions and practices are incorporated:

- a) Landfill cells must have functional and effective liners and leachate and stormwater collection and treatment systems.
- b) Fly ash should not be employed alone or in combination with bottom ash or soil unless adequately bound in a coal ash-derived material such as Agremax.

- c) The use of bottom ash and coal ash-derived materials as ADC should be initially limited at any given lined landfill to 50%/50% coal ash/soil mixtures, 6 inch (15 cm) minimum, until the landfill operators gain sufficient experience with the material to propose piloting other ADC coal ash/soil ratios and/or thicknesses.
- d) The application of bottom ash and coal ash-derived materials as ADC should not include exterior landfill side slopes (it is noted that such use presents operational and other issues with many other types of ADC). Placement should always be within the lined footprint of the landfill cell.
- e) As the net effect coal ash and coal ash-derived materials will have on hydrogen sulfide production (*i.e.*, increasing or decreasing) is unclear, a hydrogen sulfide monitoring program should be piloted.
- f) Storage, staging, and application of bottom ash and coal ash-derived materials should be done in such a way as to minimize impact on stormwater run-off.

Based on our limited review of published state summaries of ADC policies and discussions with state regulatory and permitting agencies, we would recommend directly contacting either or both of the following state agency personnel for their relevant experience:

- Paul Emond
Massachusetts Department of Environmental Protection
Phone: (617) 292-5974 Email: paul.emond@state.ma.us
- Scott Story, Chief, Solid Waste Engineering Section
Alabama Department of Environmental Management
Phone: (334) 271-7700

EPA Region 2, RCRA Compliance Branch Contacts:

- Leonard Grossman, Senior Enforcement Team Leader
(212) 637-4039, grossman.lenny@epa.gov
- Carl Plössl, Senior Enforcement Team Environmental Engineer
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